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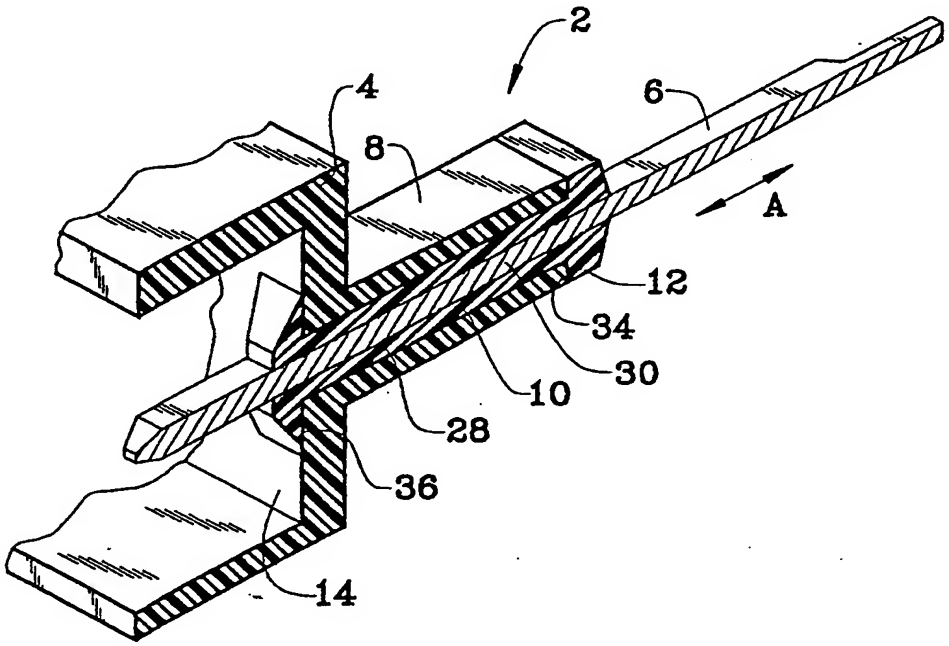

(57) Abstract

An electrical connector (2) comprises terminals (6) positioned within a housing (4). The housing (4) is provided with large cavities (10) in a first moulding step, where the terminals are subsequently positioned within the cavities and overmoulded by a second housing portion (28). The effects of deformation due to shrinkage or warpage of the housing (4), in the positioning of the terminals, is thus avoided.

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CONNECTOR WITH IN-MOULDED TERMINALS

This invention relates to a connector having a housing and terminals mounted therein, whereby the terminals are fixed to the housing by moulding over a portion of the terminals.

A common technique of manufacturing connectors is to mould a plastic housing around a mounting portion of a plurality of terminals which are thus set within the plastic of the housing. Such manufacturing techniques are commonly used for tab or pin headers, where the terminals have a very simple shape well suited for over-moulding. One of the problems encountered is the volume change and development of internal stresses when the molten plastic cools and solidifies. The latter leads to displacement of the terminals from their desired positioning, thus increasing tolerances required between mating connectors. Excessive tolerances may lead to damage of mating connectors, increase the mating forces, or damage plated contact surfaces. Such problems are further aggravated in connectors with a high density of terminals, as greater accuracy (small tolerances) in terminal positioning is needed. Furthermore, deformation of the housing around the terminals may reduce sealing integrity. Sealing integrity is particularly important in applications where the connector is positioned at an interface with large pressure differences such as vacuum chambers (e.g. for automotive braking systems) or pressure vessels.

It is an object of this invention to provide electrical connectors with improved accuracy in the positioning of terminals. It would be desirable to provide such connectors in a cost-effective form, in particular cost-effective to manufacture. It would also be desirable that such connectors are compact. It would further be

desirable to provide connectors that are particularly reliable, where terminals are securely mounted to the housings. It would also be desirable to provide connectors with high sealing integrity.

Objects of this invention have been achieved by the invention according to claim 1. In particular, an electrical connector is disclosed herein comprising a housing and one or more electrical terminals securely mounted to the housing by overmoulding mounting portions of the terminals, wherein the terminals are secured to the housing by an over-moulded portion moulded separately from the housing. The over-moulded portion occupies a cross-sectional area substantially smaller than the cross-sectional area of the housing therearound.

Objects of this invention are also achieved by providing the method of producing a connector according to claim 5. In particular, a method of manufacturing an electrical connector comprises the steps of: providing electrical terminals and a housing having one or more cavities extending therethrough where the cavities have a great cross-sectional area than the cross-sectional area of portions of the terminals to be positioned within the cavities; positioning terminals in the cavities; and subsequently injecting a moulding material in the cavities in order to secure the terminals therein.

Advantageously therefore, the terminals can be accurately positioned as the effects of shrinkage or stress due to overmoulding is minimized. Sealing integrity is also improved by avoiding the effects of deformation of the housing on the seating of the terminals. Also, slight shrinkage of the overmoulding material around the terminals even enhances the sealing effectiveness.

Further advantageous aspects of this invention are described in the claims, or will be apparent from the following description and drawings.

An embodiment of this invention will now be described by way of example, with reference to the drawings, in which;

Figure 1 is a longitudinal cross-sectional view through a connector according to this invention showing a terminal mounted in a housing;

Figure 2 is a view similar to that of Figure 1 prior to overmoulding of the terminal;

Figure 3 is a simplified cross-sectional view taken orthogonally to the terminals showing the positioning of terminals within terminal receiving cavities of the housing;

Figure 4 is a longitudinal cross-sectional view of the connector according to this invention just prior to overmoulding of the terminal, where the connector is positioned in a moulding die.

Referring to the figures, and in particular Figure 1, an electrical connector 2 (which is only shown partially) comprises a housing 4 and a plurality of terminals 6 mounted in the housing. Although only one terminal is shown, it is of course understood that a plurality of terminals arranged in one or more rows and columns may be provided. The housing 4 may be provided from a moulded dielectric such as plastic as is conventional for electrical connectors. In this embodiment, the housing 4 is moulded from plastic. It is however conceivable to provide the housing 4 in a conductive material e.g. a metal casting such as an aluminium alloy casting, or even formed from sheet metal although structural differences in the shape would be needed to make the shape manufacturable by the stamping and forming process. The housing 4 may be in a

conductive material if the terminals mounted in the housing are kept out of direct contact with the housing, which is possible with the present invention. The usefulness of conductive housings would for example apply to shielded connector systems such as used in shielded applications e.g. for high speed signal transmission. The present invention therefore also has the advantage of enabling provision of various housing materials that are not necessarily well adapted for overmoulding or attaching of terminals directly thereto.

The housing 4 is provided with a terminal mounting portion 8 provided with terminal receiving cavities 10 extending therethrough from a terminal receiving end 12 to a mating face 14, the mating face directed towards a mating connector pluggable with the connector 2. The terminal receiving cavities 10 of the housing are provided with a cross-sectional surface area (considering a section taken orthogonally to the longitudinal direction (A) of the terminal) which is greater than a cross-sectional area 18 of the terminal as best seen in Figure 3. There is therefore a certain degree of freedom for positioning of the terminal 6 within the cavity 10 to avoid the effect of tolerances in positioning of the cavities of the housing. Particularly where housings are moulded from flexible or impact-resistant plastics, the degree of shrinkage or deformation of the housing once the moulded molten plastic solidifies may exceed the tolerances required in positioning of the terminals. Certain moldable materials, such as polymers with a high glass content may deform less than more flexible materials such as certain polymers with low glass content. In certain applications the former materials may not be ideal due to functional requirements such as the need for flexibility and impact resistance.

As best shown in Figure 4, the terminals 6 are accurately positioned in a moulding machine by portions 20,22,24,26 of a moulding die that holds the terminal with respect to the housing 4 accurately in position. As best seen in Figure 3, due to deformation of the housing 4 the terminals 6,6',6'' may have different out-of-centre positions with respect to their respective cavities 10,10',10''.

The remaining portion of the cavities 10,10',10'' surrounding the terminals 6,6',6'' is then filled with a mouldable material injected into the cavities to form an attachment portion 28 overmoulded around a mounting portion 30 of the terminal 6 as best seen in Figure 1. The moulded attachment portion 28 extends beyond the terminal receiving and mating ends 12,14 respectively of the housing, the moulding portions spreading orthogonally outwards in order to overlap the connector housing faces 12,14. Retention shoulders 34,36 retain the attachment portions 28 axially (in the direction A) to the housing mounting portions 8. Slight shrinkage of the material of the attachment portion 28 during solidification enhances the sealing around the terminal between the connector terminal receiving and mating faces 12,14 such that a reliable sealed connector is provided. In other words, slight shrinkage of the attachment portion 28 compresses the abutment faces 34,36 and compresses the attachment portion around the mounting portion 30 of the terminal 6. Due to the relatively small cross-sectional area 16 of the attachment portion 28, relative to the cross-sectional area 38 of the housing surrounding the terminals as depicted in Figure 3, the effect of deformation of the attachment portion 28 is insignificant concerning positioning of the terminals.

The connector can be manufactured in a cost-effective manner by first moulding the housing 4 within the injection

moulding machine, subsequently positioning the terminals 6 through the respective cavities 10 of the housing mounting portions 8 and positioning them within the die accurately by means of the die portions 20-26, and subsequently injection moulding the attachment portion 28 around the terminal mounting portions 30, within the same machine.

Although the embodiment shown in Figures 1-4 show the terminals in the shape of elongate pins or tabs, the invention is also applicable to other terminal types, such as receptacle terminals designed to mate with pin terminals. Also, it would be possible to have the cavities 10,10',10'' interconnected together by channels 40 (Figure 3) in order to facilitate the injection moulding process by enabling the flow of moulding material from one cavity to another. Alternatively to providing channels, a single elongate cavity (viewed in cross section orthognal to the direction A) could be provided to receive a plurality of terminals, for example a row of terminals. If the cross sectional area of this cavity is substantially less than the cross-sectional size of the housing, then deformation of the overmoulding would be insignificant with respect to that of the housing. The overmoulding would also have the advantage of enabling provision of a moulding material that is less prone to deformation or internal stresses after moulding (such as high glass content polymers) whilst the housing could be provided in a more resilient plastic that would be less prone to damage/breakage by mechanical solicitation.

CLAIMS

1. An electrical connector (2) comprises a housing (4) and one or more electrical terminals (6) securely mounted to the housing by overmoulding mounting portions (30) of the terminals, characterized in that the terminals are secured to the housing by an over-moulded portion moulded (28) separately from the housing, the over-moulded portion occupying a cross-sectional area (16) substantially smaller than the cross-sectional area of the housing (4) therearound.

2. The connector of claim 1 wherein the housing is moulded from a dielectric material.

3. The connector of claim 1 or 2 wherein the overmoulded portion (28) is provided in a different material to the material of the housing.

4. The connector of claim 3 wherein the material of the overmoulded portion has the property of less deformation during solidification than the material of the housing.

5. The connector of any one the preceding claims wherein the housing is provided with one or more cavities (10,10',10'') extending therethrough from a terminal receiving end (12) to a mating end (14), the terminals being received in the one or more cavities, wherein the overmoulded portion is located within the one or more cavities.

6. The connector of claim 5 wherein separate said cavities are provided for each terminal (6).

7. The connector of claim 6 wherein the cavities are interconnected by communicating channels (40) therebetween.

8. The connector of any one of claims 1-6 wherein a plurality of terminals (6) are provided in a single said cavity.

9. A method of manufacturing an electrical connector (2) comprises the steps of: providing terminals (6), and a connector housing (4) having one or more cavities (10,10',10'') extending therethrough where the housing cavity or cavities have a greater cross-sectional area than the cross-sectional area of portions (30) of the terminals positioned within the cavities; positioning terminals in the cavities; and subsequently injecting a moulding material in the cavities in order to secure the terminals to the housing.

10. The method of manufacturing an electrical connector according to claim 9 wherein the connector is provided according to any one of claims 1-8.

FIG. 1

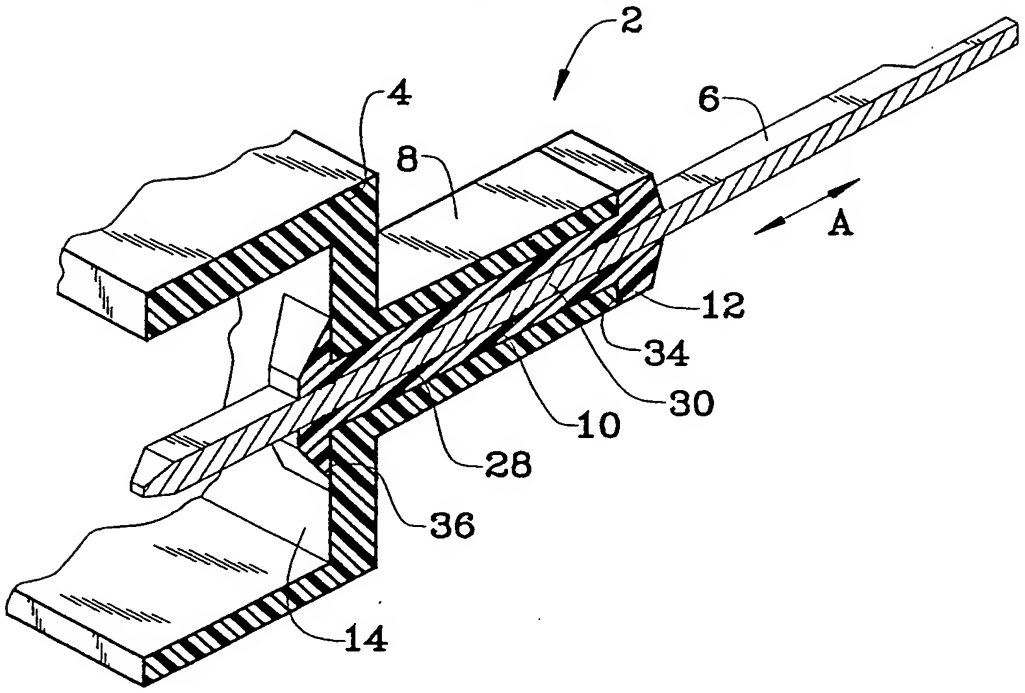


FIG. 2

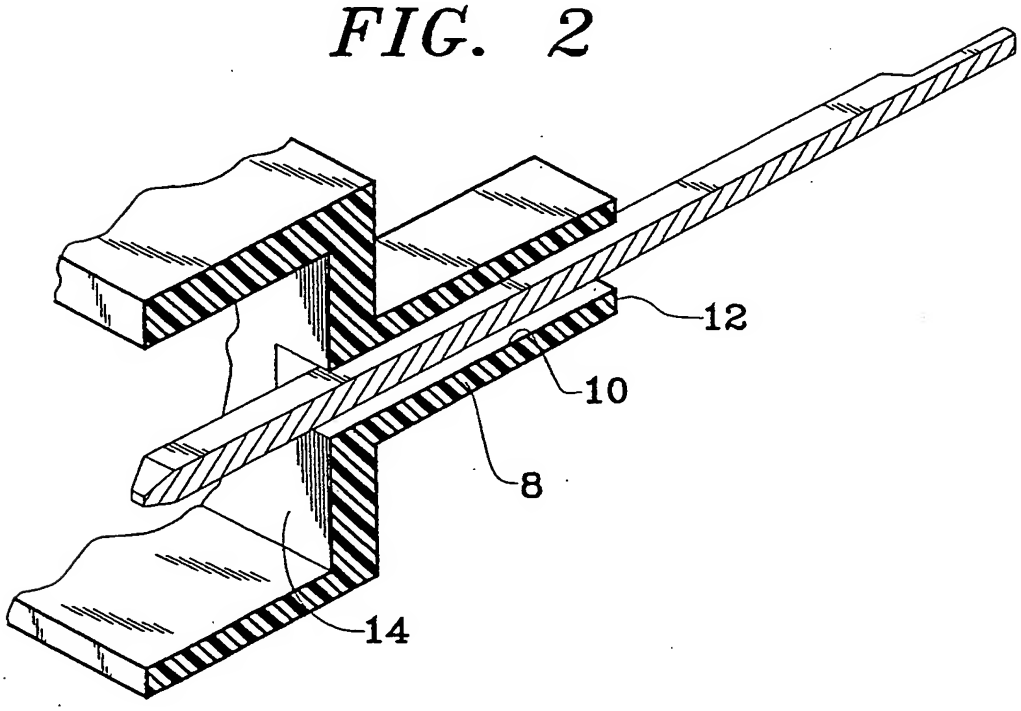


FIG. 3

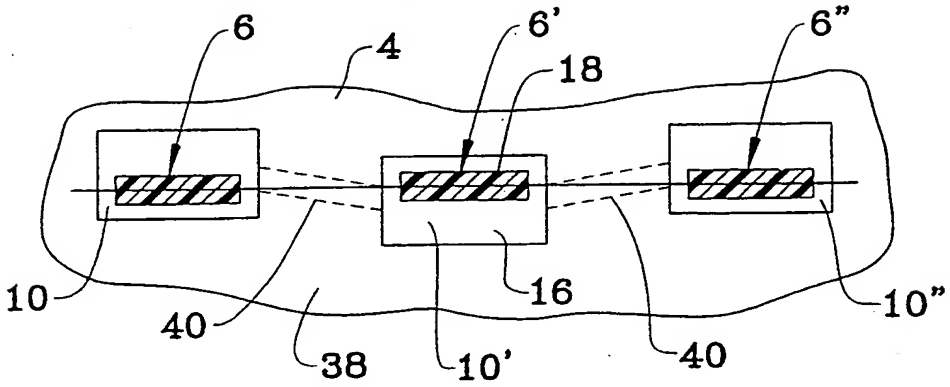
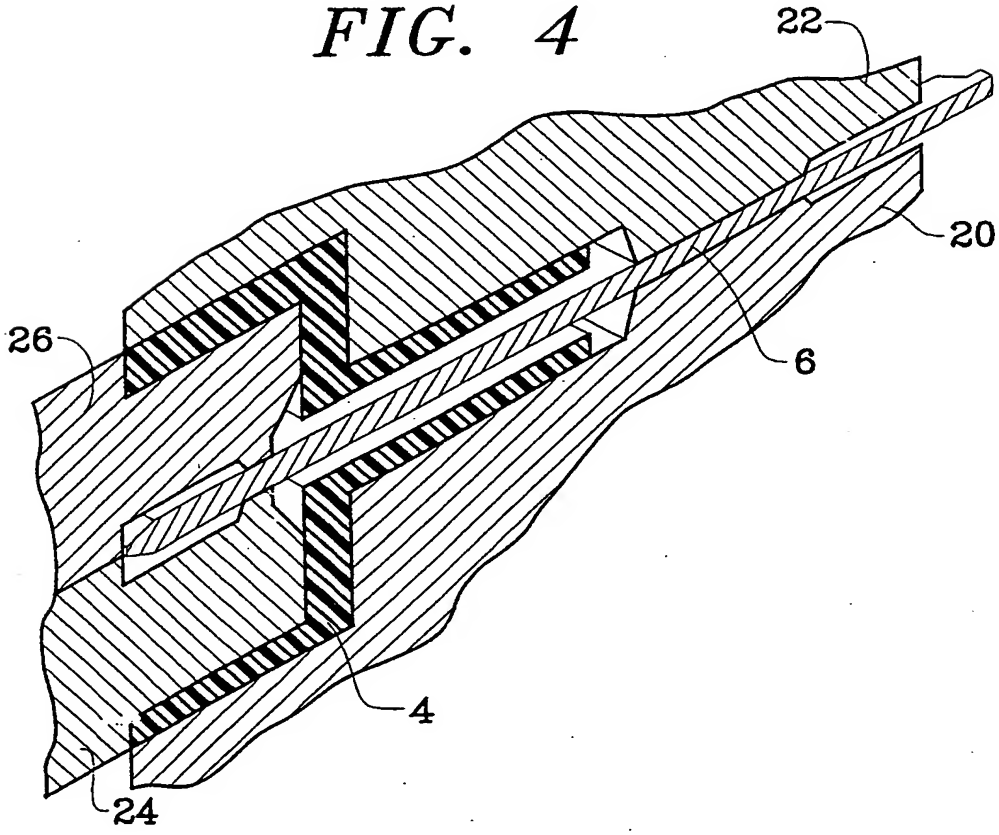


FIG. 4



INTERNATIONAL SEARCH REPORT

Interna al Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01R43/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 271 890 A (GEM MACHINERY INDUSTRY COMPANY) 27 April 1994 see page 4, paragraph 1 - page 5, paragraph 1 see figures 1-5	1,2,5,6, 9,10
X	FR 2 677 178 A (CIT ALCATEL) 4 December 1992	1,2,5,6
A	see page 4, line 34 - page 5, line 30 see figures 3-6	10
A	US 5 453 029 A (MOLDENHAUER DAVID W ET AL) 26 September 1995 see column 2, line 16 - line 67 see figures 1-5	1-3,5,6, 9,10

☐ Further documents are listed in the continuation of box C.

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2271890 A	27-04-94	NONE	
FR 2677178 A	04-12-92	NONE	
US 5453029 A	26-09-95	NONE	